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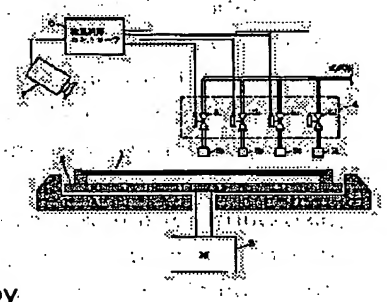
(54) SINGLE SUBSTRATE PROCESSING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To supply a processing liquid properly and uniformly adjust the surface temperature of a substrate.

SOLUTION: Four nozzles 5a-5d are arranged at positions which are differently distant respectively, toward the outer periphery from the rotary center of a substrate 1. A radiation thermometer 7 constantly detects the surface temperature distribution of the substrate 1 and the detection results are output to a flow rate controller 6. The radiation thermometer 7 indicates the surface temperature of the rapidly rotating substrate 1 as a concentric temperature distribution. The flow rate controller 6 analyzes the detected results of the temperature distribution received from the radiation thermometer 7, and controls the flow rate of a processing liquid by adjusting the individual opening levels of valves 4a-4d on a processing liquid supply device 4 so that the surface temperature of the substrate 1 is uniform.



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CLAIMS

[Claim(s)]

[Claim 1] A substrate rotation means to be the single-wafer-processing substrate processor which supplies processing liquid to the front face of the rotating substrate, and to rotate said substrate, Two or more nozzles which are located in distance which is different toward the direction of a periphery, respectively from the center of rotation of said substrate, and supply said processing liquid on the substrate concerned, Two or more flow regulation means which carry out adjustable [of the flow rate of said processing liquid which corresponds to each of two or more of said nozzles, and two or more nozzles concerned supply], A single-wafer-processing substrate processor equipped with a temperature detection means to detect distribution of the skin temperature of said whole substrate, and the flow rate control means which controls said two or more flow regulation means according to an individual based on the contents of detection of said temperature detection means so that distribution of the skin temperature of said substrate becomes uniform.

[Claim 2] A substrate rotation means to be the single-wafer-processing substrate processor which supplies the processing liquid of M (M is two or more integers) class with which only temperature differs to the front face of the rotating substrate, and to rotate said substrate, The nozzle of N (N is two or more integers) individual which is located in distance which is different toward the direction of a periphery, respectively from the center of rotation of said substrate, and supplies said M kinds of processing liquid on the substrate concerned, The flow regulation means of the individual which carries out adjustable [of the flow rate of M kinds of said processing liquid which corresponds to each of the nozzle of said N individual, and the nozzle of the N individual concerned supplies] (MxN), A single-wafer-processing substrate processor equipped with a temperature detection means to detect distribution of the skin temperature of said whole substrate, and the flow rate control means which controls the flow regulation means of the aforementioned (MxN) individual according to an individual based on the contents of detection of said temperature detection means so that distribution of the skin temperature of said substrate becomes uniform.

[Claim 3] Said flow rate control means is a single-wafer-processing substrate processor according to claim 2 characterized by controlling the flow regulation means of the aforementioned (MxN) individual so that the processing liquid with which flow rates differ at the same temperature from the nozzle of said N individual is supplied.

[Claim 4] Said flow rate control means is a single-wafer-processing substrate processor according to claim 2 characterized by controlling the flow regulation means of the aforementioned (MxN) individual so that the processing liquid of temperature which is different by the same flow rate from the nozzle of said N individual is supplied.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] More specifically, this invention relates to the single-wafer-processing substrate processor which supplies processing liquid (a drug solution, pure water, etc.), and processes arbitration on the surface of substrates (a semi-conductor wafer, the glass substrate for liquid crystal displays, the glass substrate for photo masks, substrate for optical disks, etc.) about a single-wafer-processing substrate processor.

[0002]

[Description of the Prior Art] From the former, a single-wafer-processing substrate processor exists as equipment which performs surface preparation (etching, washing, photoresist spreading, development, etc.) of a substrate using processing liquid. This single-wafer-processing substrate processor is equipment which supplies processing liquid to the rotating substrate and performs surface treatment.

[0003] Drawing 4 is drawing of longitudinal section of the conventional single-wafer-processing substrate processor. In drawing 4 , the conventional single-wafer-processing substrate processor is equipped with the spin base 2 which holds a substrate 1 fixed, the motor 3 which carries out high-speed rotation of the spin base 2, and the processing liquid feeder 4 which supplies processing liquid to a part for the surface core of a substrate 1 from nozzle 5a. The processing liquid feeder 4 opens and closes bulb 4a, and supplies processing liquid.

[0004] The conventional single-wafer-processing substrate processor is supplying processing liquid to a part for the core of the substrate 1 which carries out high-speed rotation from nozzle 5a, and supplying the processing liquid from a part for a core to the periphery part of a substrate 1 by the above-mentioned configuration, using the centrifugal force of a substrate 1, and makes surface treatment of the substrate 1 whole possible.

[0005]

[Problem(s) to be Solved by the Invention] Here, in order that the processing liquid used for the surface treatment of a substrate 1 may pull out the treatment effect to the maximum extent, what was adjusted to the temperature defined beforehand is used.

[0006] however — in order to only supply processing liquid to one place for a core of a substrate 1, until it supplies processing liquid to the periphery part of a substrate 1 in the above-mentioned conventional single-wafer-processing substrate processor using a centrifugal force — processing liquid — heat dissipation — or endoergic is carried out and whenever [processing solution temperature / of the substrate 1 whole] does not become homogeneity. That is, the temperature of the processing liquid for a core of a substrate 1 will differ from the temperature of the processing liquid of a periphery part.

[0007] Thus, when the temperature of the processing liquid of the substrate 1 whole does not become homogeneity, removal of the organic-substance metallurgy group and the particle held using hot processing liquid etc. lacks in the homogeneity of processing, and the problem that where of the progress condition of etching becomes an ununiformity in a part for a core and the periphery part of a substrate 1 produces it by that processing liquid is expensive than ordinary temperature or it being low in etching performed using the processing liquid before and behind ordinary temperature.

[0008] So, the purpose of this invention is offering the single-wafer-processing substrate processor which supplies processing liquid appropriately and adjusts the skin temperature of a substrate to homogeneity.

[0009]

[The means for solving a technical problem and an effect of the invention] A substrate rotation means for the 1st invention to be a single-wafer-processing substrate processor which supplies processing liquid to the front face of the rotating substrate, and to rotate a substrate, Two or more nozzles which are located in distance which is different toward the direction of a periphery, respectively from the center of rotation of a substrate, and supply processing liquid on the substrate concerned, Two or more flow regulation means which carry out adjustable [of the flow rate of the processing liquid which corresponds to each of two or more nozzles, and two or more nozzles concerned supply], It has a temperature detection means to detect distribution of the skin temperature of the whole substrate, and the flow rate control means which controls two or more flow regulation means according to an individual based on the contents of detection of a temperature detection means so that distribution of the skin temperature of a substrate becomes uniform.

[0010] As mentioned above, according to the 1st invention, skin temperature of a substrate can be made into

homogeneity by operating two or more flow regulation means corresponding to the temperature distribution always detected with a temperature detection means, and carrying out increase and decrease of the amount of supply of the processing liquid from two or more nozzles of control appropriately. Therefore, the homogeneity of the surface treatment of a substrate improves.

[0011] A substrate rotation means for the 2nd invention to be a single-wafer-processing substrate processor which supplies the processing liquid of M (M is two or more integers) class with which only temperature differs to the front face of the rotating substrate, and to rotate a substrate, The nozzle of N (N is two or more integers) individual which is located in distance which is different toward the direction of a periphery, respectively from the center of rotation of a substrate, and supplies M kinds of processing liquid on the substrate concerned, The flow regulation means of the individual which carries out adjustable [of the flow rate of M kinds of processing liquid which corresponds to each of the nozzle of N individual and the nozzle of the N individual concerned supplies] (MxN), It has a temperature detection means to detect distribution of the skin temperature of the whole substrate, and the flow rate control means which controls the flow regulation means of an individual according to an individual based on the contents of detection of a temperature detection means so that distribution of the skin temperature of a substrate becomes uniform (MxN).

[0012] As mentioned above, according to the 2nd invention, it has the flow regulation means of N individual for M kinds from which only the temperature to supply differs of every processing liquid. And skin temperature of a substrate can be made into homogeneity by operating the flow regulation means of an individual (MxN) corresponding to the temperature distribution always detected with a temperature detection means, and carrying out increase and decrease of the amount of supply of the processing liquid from the nozzle of N individual of control appropriately. Therefore, the homogeneity of the surface treatment of a substrate improves.

[0013] 3rd invention is characterized by a flow rate control means controlling the flow regulation means of an individual so that the processing liquid with which flow rates differ at the same temperature from the nozzle of N individual is supplied (MxN) in the 2nd invention.

[0014] The 3rd invention considers the control approach of the flow rate control means in the 2nd invention as control by the flow rate of processing liquid.

[0015] 4th invention is characterized by a flow rate control means controlling the flow regulation means of an individual so that the processing liquid of temperature which is different by the same flow rate from the nozzle of N individual is supplied (MxN) in the 2nd invention.

[0016] The 4th invention considers the control approach of the flow rate control means in the 2nd invention as control by the temperature of processing liquid.

[0017]

[Embodiment of the Invention] (1st operation gestalt) Drawing 1 is drawing of longitudinal section of the single-wafer-processing substrate processor concerning the 1st operation gestalt of this invention. In drawing 1, the single-wafer-processing substrate processor of the operation gestalt of **** 1 is equipped with the spin base 2 which holds a substrate 1 free [rotation], the motor 3 which carries out high-speed rotation of the spin base 2, the processing liquid feeder 4 which supplies processing liquid to the front face of a substrate 1 from four nozzles 5a-5d, the control-of-flow controller 6 which controls the flow rate of the processing liquid of the processing liquid feeder 4, and the radiation thermometer 7 which detect the temperature distribution of substrate 1 front face. The processing liquid feeder 4 is equipped with four bulbs 4a-4d.

[0018] Four nozzles 5a-5d are formed in the location in distance which is different toward the direction of a periphery, respectively from the center of rotation of a substrate 1. The radiation thermometer 7 has always detected the temperature distribution of substrate 1 front face, and outputs the result of the temperature distribution to the control-of-flow controller 6. Here, a radiation thermometer 7 will regard the skin temperature of the substrate 1 which carries out high-speed rotation as concentric circle-like temperature distribution. The control-of-flow controller 6 adjusts bulbs [of the processing liquid feeder 4 / 4a-4d] opening level separately, and controls the flow rate of processing liquid so that the temperature-distribution result received from the radiation thermometer 7 is analyzed and the skin temperature of a substrate 1 becomes homogeneity.

[0019] Control performed by the control-of-flow controller 6 is performed by [as being the following]. When it must process in the range whose skin temperature of a substrate 1 is 78 degrees C - 80 degrees C using 80-degree C processing liquid, When from a part for a core to the periphery part of a substrate 1 serves as temperature distribution of the shape of a concentric circle which is 80 degrees C - 70 degrees C as a result of the first processing liquid supply (see drawing 2) processing — liquid — a flow rate — "— a nozzle — five — d

— it is — a flow rate — > — a nozzle — five — c — a flow rate — > — a nozzle — five — b — a flow rate — > — a nozzle — five — a — a flow rate — " — becoming — as — Bulbs [4a–4d] opening level — respectively — an individual exception — controlling . That is, it is that which increases the amount of supply of the processing liquid to a periphery part with low temperature, and reduces the amount of supply of the processing liquid for a core (or now is still sufficient as the amount of supply for a core).

[0020] As mentioned above, the single–wafer–processing substrate processor of the operation gestalt of **** 1 can change the each bulbs [4a–4d] amount of openings corresponding to the always detected temperature distribution, and can make skin temperature of a substrate 1 homogeneity by carrying out increase and decrease of the amount of supply of the processing liquid from each nozzles 5a–5d of control appropriately. In addition, control of Bulbs 4a–4d can also be carried out fixed by the ratio simply obtained from analysis or an actual proof besides the approach of making follow the temperature distribution detected as mentioned above, and tuning opening level finely according to an individual.

[0021] (2nd operation gestalt) Drawing 3 is drawing of longitudinal section of the single–wafer–processing substrate processor concerning the 2nd operation gestalt of this invention. In drawing 3 the single–wafer–processing substrate processor of the operation gestalt of **** 2 The spin base 2 held for a substrate 1, enabling free rotation, and the motor 3 which carries out high–speed rotation of the spin base 2, It has the processing liquid feeder 4 which supplies the 1st and 2nd processing liquid to the front face of a substrate 1 from four nozzles 5a–5d, the control–of–flow controller 6 which controls the flow rate of the 1st of the processing liquid feeder 4, and the 2nd processing liquid, and the radiation thermometer 7 which detects the temperature distribution of substrate 1 front face. The processing liquid feeder 4 is equipped with eight bulbs 4a–4h.

[0022] The single–wafer–processing substrate processor of the operation gestalt of **** 2 has two processing liquid supply networks in the processing liquid feeder 4 compared with the single–wafer–processing substrate processor of the operation gestalt of the above 1st so that drawing 3 may also show (a Bulbs [4a–4d] network and Bulbs [4e–4h] network). And in this processing liquid feeder 4, although it is of the same kind, the 1st and 2nd processing liquid with which temperature differs is supplied to Bulbs 4a–4d and Bulbs 4e–4h, respectively.

[0023] Here, when the temperature of the 1st processing liquid is [the temperature of the 2nd processing liquid] 90 degrees C at 80 degrees C, control performed by the control–of–flow controller 6 is performed by [as being the following]. When it must process in the range whose skin temperature of a substrate 1 is 78 degrees C – 80 degrees C, When from a part for a core to the periphery part of a substrate 1 serves as temperature distribution of the shape of a concentric circle which is 80 degrees C – 70 degrees C as a result of the first processing liquid supply (see drawing 2) Closing motion of Bulbs 4a–4h is controlled according to an individual, respectively to supply the 2nd processing liquid to nozzle 5c and nozzle 5d, and to supply the 1st processing liquid to nozzle 5a and nozzle 5b (Bulbs 4c, 4d, 4e, and 4f are stopped, and opening of the bulbs 4a, 4b, 4g, and 4h is carried out). At this time, Bulbs [4a–4h] opening level may be controlled according to an individual, respectively to become "the flow rate of flow rate > nozzle 5a of flow rate > nozzle 5b of nozzle 5d flow rate > nozzle 5c" at coincidence. Moreover, it is also possible by changing the rate of a throat area ratio (bulb 4a, bulb 4e and bulb 4b, bulb 4f and bulb 4c, bulb 4g or bulb 4d, and bulb 4h) to mix and supply the 1st processing liquid and the 2nd processing liquid.

[0024] As mentioned above, the single–wafer–processing substrate processor of the operation gestalt of **** 2 can make skin temperature of a substrate 1 homogeneity early more compared with the single–wafer–processing substrate processor of the operation gestalt of the above 1st by using the temperature control of processing liquid, control of flow, or its both sides by having a processing liquid feed zone to the processing liquid with which temperature differs, respectively. In addition, the processing liquid of a different class can also be used for two processing liquid feed zones in the processing liquid feeder 4.

[0025] In addition, in the single–wafer–processing substrate processor of the above 1st and the 2nd operation gestalt, although explained using four bulbs 4a–4d (and bulbs 4e–4h), the number of bulbs is not restricted to this, but can set up the number freely. Moreover, although the single–wafer–processing substrate processor of the operation gestalt of the above 2nd explained the case where it had two processing liquid feed zones, the number of networks of a processing liquid feed zone is not restricted to this, either, but the number can be set up freely. furthermore — although four nozzles 5a–5d were formed to eight bulbs 4a–4h in the single–wafer–processing substrate processor of the operation gestalt of the above 2nd — eight bulbs 4 — a nozzle may be prepared every a–4h, respectively. Moreover, with the above 1st and the 2nd operation gestalt, although the flow rate was controlled by Bulbs 4a–4h, it may replace with a bulb, a flow rate may be controlled using a regulator, and a means to adjust a flow rate is not limited to a bulb.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing of longitudinal section of the single-wafer-processing substrate processor concerning the 1st operation gestalt of this invention.
[Drawing 2] It is drawing showing an example of the temperature distribution of substrate 1 front face.
[Drawing 3] It is drawing of longitudinal section of the single-wafer-processing substrate processor concerning the 2nd operation gestalt of this invention.
[Drawing 4] It is drawing of longitudinal section of the conventional single-wafer-processing substrate processor.
[Description of Notations]
1 -- Substrate
2 -- Spin base
3 -- Motor
4 -- Processing liquid feeder
4a-4h -- Bulb
5a-5d -- Nozzle
6 -- Control-of-flow controller
7 -- Radiation thermometer

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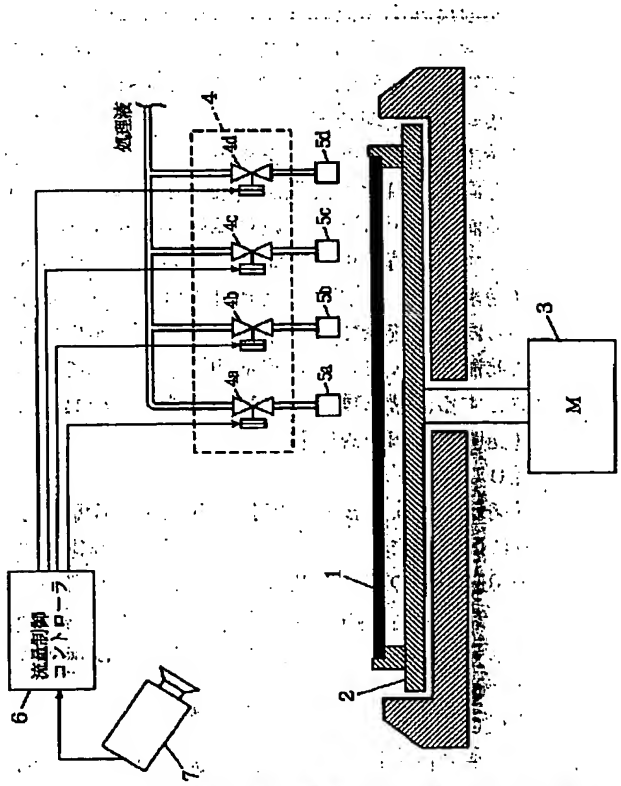
(54)【発明の名称】　枚葉式基板処理装置

(57)【要約】
【課題】　処理液を適切に供給し、基板の表面温度を均一に調整する枚葉式基板処理装置を提供する。
【解決手段】　４つのノズル５ａ～５ｄは、基板１の回転中心から外周方向へ向かって、それぞれ異なる距離にある位置に設けられている。放射温度計７は、常時基板１表面の温度分布を検出しており、その温度分布の結果を流量制御コントローラ６へ出力する。ここで、放射温度計７は、高速回転する基板１の表面温度を同心円状の温度分布としてとらえることになる。流量制御コントローラ６は、放射温度計７から受けた温度分布結果を解析し、基板１の表面温度が均一になるように、処理液供給装置４のバルブ４ａ～４ｄの開口レベルを個々に調整して処理液の流量を制御する。



1

【特許請求の範囲】

【請求項１】 回転する基板の表面に処理液を供給する枚葉式基板処理装置であって、

前記基板を回転させる基板回転手段と、

前記基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、前記処理液を当該基板上に供給する複数のノズルと、

前記複数のノズルのそれぞれに対応し、当該複数のノズルが供給する前記処理液の流量を可変する複数の流量調節手段と、

前記基板全体の表面温度の分布を検出する温度検出手段と、

前記温度検出手段の検出内容に基づいて、前記基板の表面温度の分布が均一となるように前記複数の流量調節手段を個別に制御する流量制御手段とを備える、枚葉式基板処理装置。

【請求項２】 回転する基板の表面に温度のみ異なるM（Mは２以上の整数）種類の処理液を供給する枚葉式基板処理装置であって、

前記基板を回転させる基板回転手段と、

前記基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、前記M種類の処理液を当該基板上に供給するN（Nは２以上の整数）個のノズルと、

前記N個のノズルのそれぞれに対応し、当該N個のノズルが供給する前記M種類の処理液の流量を可変する（M×N）個の流量調節手段と、

前記基板全体の表面温度の分布を検出する温度検出手段と、

前記温度検出手段の検出内容に基づいて、前記基板の表面温度の分布が均一となるように前記（M×N）個の流量調節手段を個別に制御する流量制御手段とを備える、枚葉式基板処理装置。

【請求項３】 前記流量制御手段は、前記N個のノズルから同一の温度で流量が異なる処理液が供給されるように前記（M×N）個の流量調節手段を制御することを特徴とする、請求項２に記載の枚葉式基板処理装置。

【請求項４】 前記流量制御手段は、前記N個のノズルから同一の流量で異なる温度の処理液が供給されるように前記（M×N）個の流量調節手段を制御することを特徴とする、請求項２に記載の枚葉式基板処理装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、枚葉式基板処理装置に関し、より特定的には、基板（半導体ウエハ、液晶表示装置用のガラス基板、フォトマスク用のガラス基板、光ディスク用の基板等）の表面に、処理液（薬液、純水等）を供給して任意の処理を行う枚葉式基板処理装置に関する。

【０００２】

【従来の技術】従来から、処理液を用いて基板の表面処理（エッチング、洗浄、フォトレジスト塗布、現像等）を行う装置として、枚葉式基板処理装置が存在する。この枚葉式基板処理装置とは、回転する基板に処理液を供給して、表面処理を行う装置である。

2

【０００３】図４は、従来の枚葉式基板処理装置の縦断面図である。図４において、従来の枚葉式基板処理装置は、基板１を固定的に保持するスピンベース２と、スピンベース２を高速回転させるモータ３と、基板１の表面中心部分にノズル５ａから処理液を供給する処理液供給装置４とを備える。処理液供給装置４は、バルブ４ａを開閉して処理液を供給する。

【０００４】従来の枚葉式基板処理装置は、上記構成により、高速回転する基板１の中心部分にノズル５ａから処理液を供給し、基板１の遠心力を利用して基板１の中心部分から外周部分への処理液の供給を行うことで、基板１全体の表面処理を可能としている。

【０００５】

【発明が解決しようとする課題】ここで、基板１の表面処理に使用する処理液は、その処理効果を最大限に引き出すために予め定めた温度に調整したものが用いられる。

【０００６】しかし、上記従来の枚葉式基板処理装置においては、基板１の中心部分の１箇所に処理液を供給するだけであるため、処理液を遠心力を利用して基板１の外周部分へ供給するまでに処理液が放熱または吸熱してしまい、基板１全体の処理液温度が均一にならない。すなわち、基板１の中心部分の処理液の温度と外周部分の処理液の温度とが異なってしまうのである。

【０００７】このように、基板１全体の処理液の温度が均一にならない場合、例えば、高温の処理液を用いて行う有機物や金属およびパーティクルの除去等は、処理の均一性に欠け、常温前後の処理液を用いて行うエッチングにおいては、処理液が常温より高いか低いかによって、基板１の中心部分と外周部分とでエッチングの進み具合が不均一になるという問題が生じる。

【０００８】それ故、本発明の目的は、処理液を適切に供給し、基板の表面温度を均一に調整する枚葉式基板処理装置を提供することである。

【０００９】

【課題を解決するための手段および発明の効果】第１の発明は、回転する基板の表面に処理液を供給する枚葉式基板処理装置であって、基板を回転させる基板回転手段と、基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、処理液を当該基板上に供給する複数のノズルと、複数のノズルのそれぞれに対応し、当該複数のノズルが供給する処理液の流量を可変する複数の流量調節手段と、基板全体の表面温度の分布を検出する温度検出手段と、温度検出手段の検出内容に基づいて、基板の表面温度の分布が均一となるように複数の流量調節手段を個別に制御する流量制御手段とを備える。

【００１０】上記のように、第１の発明によれば、温度検出手段で常時検出する温度分布に対応して複数の流量調節手段を操作して、複数のノズルからの処理液の供給量を適切に増減制御してやることで、基板の表面温度を均一にすることができる。従って、基板の表面処理の均一性が向上する。

【００１１】第２の発明は、回転する基板の表面に温度のみ異なるM（Mは２以上の整数）種類の処理液を供給する枚葉式基板処理装置であって、基板を回転させる基板回転手段と、基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、M種類の処理液を当該基板上に供給するN（Nは２以上の整数）個のノズルと、N個のノズルのそれぞれに対応し、当該N個のノズルが供給するM種類の処理液の流量を可変する（M×N）個の流量調節手段と、基板全体の表面温度の分布を検出する温度検出手段と、温度検出手段の検出内容に基づいて、基板の表面温度の分布が均一となるように（M×N）個の流量調節手段を個別に制御する流量制御手段とを備える。

【００１２】上記のように、第２の発明によれば、供給する温度のみ異なるM種類の処理液ごとにN個の流量調節手段を備えている。そして、温度検出手段で常時検出する温度分布に対応して（M×N）個の流量調節手段を操作して、N個のノズルからの処理液の供給量を適切に増減制御してやることで、基板の表面温度を均一にすることができる。従って、基板の表面処理の均一性が向上する。

【００１３】第３の発明は、第２の発明において、流量制御手段は、N個のノズルから同一の温度で流量が異なる処理液が供給されるように（M×N）個の流量調節手段を制御することを特徴とする。

【００１４】第３の発明は、第２の発明における流量制御手段の制御方法を、処理液の流量による制御としたものである。

【００１５】第４の発明は、第２の発明において、流量制御手段は、N個のノズルから同一の流量で異なる温度の処理液が供給されるように（M×N）個の流量調節手段を制御することを特徴とする。

【００１６】第４の発明は、第２の発明における流量制御手段の制御方法を、処理液の温度による制御としたものである。

【００１７】

【発明の実施の形態】（第１の実施形態）図１は、本発明の第１の実施形態に係る枚葉式基板処理装置の縦断面図である。図１において、本第１の実施形態の枚葉式基板処理装置は、基板１を回転自在に保持するスピンベース２と、スピンベース２を高速回転させるモータ３と、基板１の表面に４つのノズル５ａ～５ｄから処理液を供給する処理液供給装置４と、処理液供給装置４の処理液の流量を制御する流量制御コントローラ６と、基板１表面の温度分布を検出する放射温度計７とを備える。処理液供給装置４は、４つのバルブ４ａ～４ｄを備える。

【００１８】４つのノズル５ａ～５ｄは、基板１の回転中心から外周方向へ向かって、それぞれ異なる距離にある位置に設けられている。放射温度計７は、常時基板１表面の温度分布を検出しており、その温度分布の結果を流量制御コントローラ６へ出力する。ここで、放射温度計７は、高速回転する基板１の表面温度を同心円状の温度分布としてとらえることになる。流量制御コントローラ６は、放射温度計７から受けた温度分布結果を解析し、基板１の表面温度が均一になるように、処理液供給装置４のバルブ４ａ～４ｄの開口レベルを個々に調整して処理液の流量を制御する。

【００１９】流量制御コントローラ６で行う制御は、例えば、以下の様にして行う。８０℃の処理液を用いて、基板１の表面温度が７８℃～８０℃の範囲において処理を行わなければならないとき、最初の処理液供給の結果、基板１の中心部分から外周部分までが８０℃～７０℃の同心円状の温度分布となっている場合（図２を参照）には、処理液の流量が「ノズル５ｄの流量＞ノズル５ｃの流量＞ノズル５ｂの流量＞ノズル５ａの流量」となるようにバルブ４ａ～４ｄの開口レベルをそれぞれ個別に制御する。すなわち、温度の低い外周部分への処理液の供給量を増やし、中心部分への処理液の供給量を減らす（または、中心部分の供給量は今のままでもよい）のである。

【００２０】以上のように、本第１の実施形態の枚葉式基板処理装置は、常時検出する温度分布に対応して各バルブ４ａ～４ｄの開口量を変化させ、各ノズル５ａ～５ｄからの処理液の供給量を適切に増減制御してやることで、基板１の表面温度を均一にすることができる。なお、バルブ４ａ～４ｄの制御は、上記のように検出した温度分布に追従させて開口レベルを個別に微調整する方法のほか、単純に解析や実証から得た比率で固定的に行うことも可能である。

【００２１】（第２の実施形態）図３は、本発明の第２の実施形態に係る枚葉式基板処理装置の縦断面図である。図３において、本第２の実施形態の枚葉式基板処理装置は、基板１を回転自在に保持するスピンベース２と、スピンベース２を高速回転させるモータ３と、基板１の表面に４つのノズル５ａ～５ｄから第１および第２の処理液を供給する処理液供給装置４と、処理液供給装置４の第１および第２の処理液の流量を制御する流量制御コントローラ６と、基板１表面の温度分布を検出する放射温度計７とを備える。処理液供給装置４は、８つのバルブ４ａ～４ｈを備える。

【００２２】図３からも分かるように、本第２の実施形態の枚葉式基板処理装置は、上記第１の実施形態の枚葉式基板処理装置に比べ、処理液供給装置４内に処理液供給系統を２つ有している（バルブ４ａ～４ｄの系統とバ

5

ルブ４ｅ～４ｈの系統）。そして、この処理液供給装置４において、バルブ４ａ～４ｄおよびバルブ４ｅ～４ｈには、同種類であるが温度が異なる第１および第２の処理液がそれぞれ供給される。

【００２３】ここで、第１の処理液の温度が８０℃で第２の処理液の温度が９０℃である場合、流量制御コントローラ６で行う制御は、例えば、以下の様にして行う。基板１の表面温度が７８℃～８０℃の範囲において処理を行わなければならないとき、最初の処理液供給の結果、基板１の中心部分から外周部分までが８０℃～７０℃の同心円状の温度分布となっている場合（図２を参照）には、ノズル５ｃおよびノズル５ｄに第２の処理液を供給し、ノズル５ａおよびノズル５ｂには第１の処理液を供給するようにバルブ４ａ～４ｈの開閉をそれぞれ個別に制御する（バルブ４ｃ，４ｄ，４ｅ，４ｆを閉止し、バルブ４ａ，４ｂ，４ｇ，４ｈを開口する）。このとき、同時に「ノズル５ｄの流量＞ノズル５ｃの流量＞ノズル５ｂの流量＞ノズル５ａの流量」となるようにバルブ４ａ～４ｈの開口レベルをそれぞれ個別に制御してもよい。また、バルブ４ａとバルブ４ｅ，バルブ４ｂとバルブ４ｆ，バルブ４ｃとバルブ４ｇまたはバルブ４ｄとバルブ４ｈの開口比率を変化させることにより、第１の処理液と第２の処理液とを混合して供給することも可能である。

【００２４】以上のように、本第２の実施形態の枚葉式基板処理装置は、温度の異なる処理液に対しそれぞれ処理液供給部を有することにより、処理液の温度制御または流量制御若しくはその双方を用いることで、上記第１の実施形態の枚葉式基板処理装置に比べ、より早く基板１の表面温度を均一にすることができる。なお、処理液供給装置４内の２系統の処理液供給部には、異なる種類の処理液を用いることもできる。

6

【００２５】なお、上記第１および第２の実施形態の枚葉式基板処理装置では、４つのバルブ４ａ～４ｄ（およびバルブ４ｅ～４ｈ）を用いて説明したが、バルブの数はこれに限られず自由にその数を設定することができる。また、上記第２の実施形態の枚葉式基板処理装置では、２系統の処理液供給部を有する場合を説明したが、処理液供給部の系統数もこれに限られず自由にその数を設定することができる。さらに、上記第２の実施形態の枚葉式基板処理装置では、８つのバルブ４ａ～４ｈに対して４つのノズル５ａ～５ｄを設けたが、８つのバルブ４ａ～４ｈごとにそれぞれノズルを設けてもよい。また、上記第１および第２の実施形態では、バルブ４ａ～４ｈで流量を制御したが、バルブに代えてレギュレータを使用して流量を制御してもよく、流量を調節する手段はバルブに限定されるものではない。

【図面の簡単な説明】

【図１】本発明の第１の実施形態に係る枚葉式基板処理装置の縦断面図である。

【図２】基板１表面の温度分布の一例を示す図である。

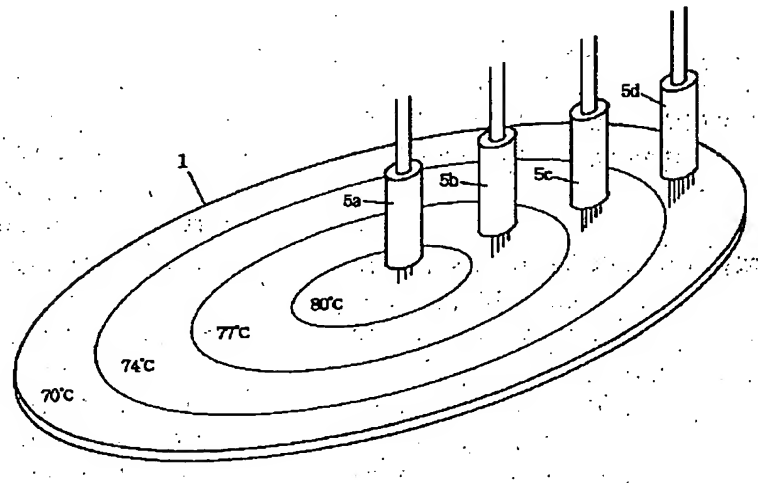
【図３】本発明の第２の実施形態に係る枚葉式基板処理装置の縦断面図である。

【図４】従来の枚葉式基板処理装置の縦断面図である。

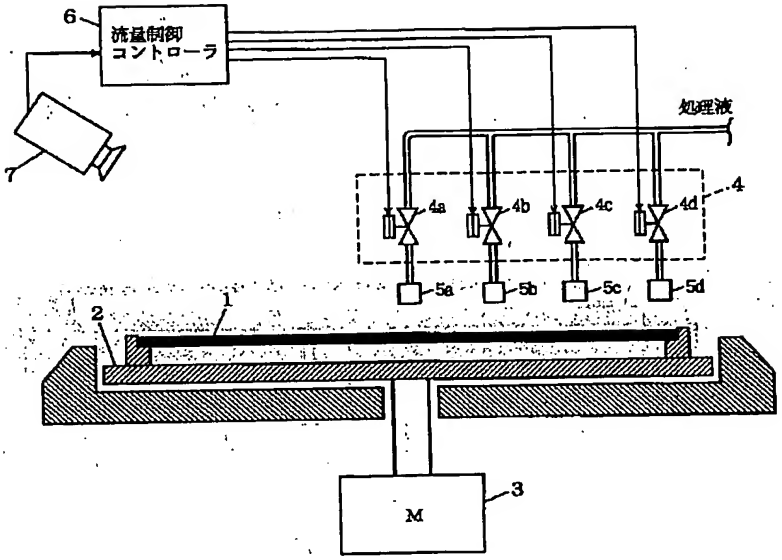
【符号の説明】

１…基板
２…スピンベース
３…モータ
４…処理液供給装置
４ａ～４ｈ…バルブ
５ａ～５ｄ…ノズル
６…流量制御コントローラ
７…放射温度計

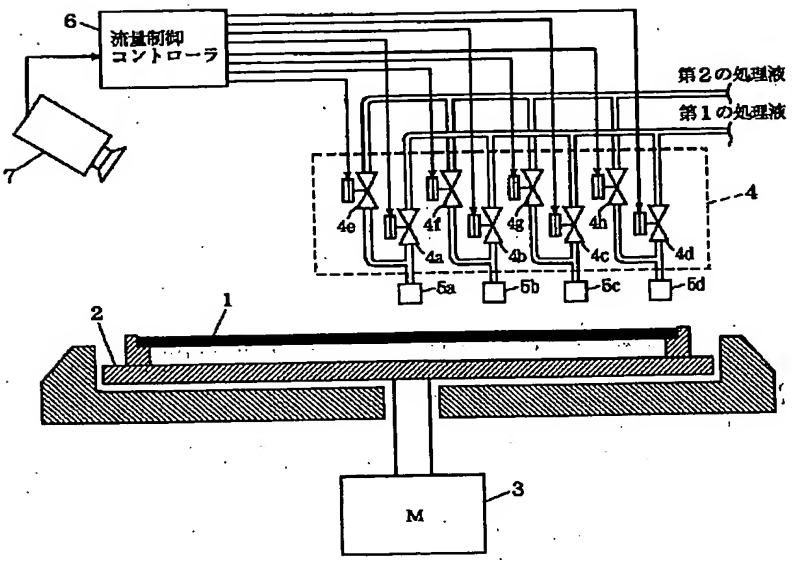
【図２】



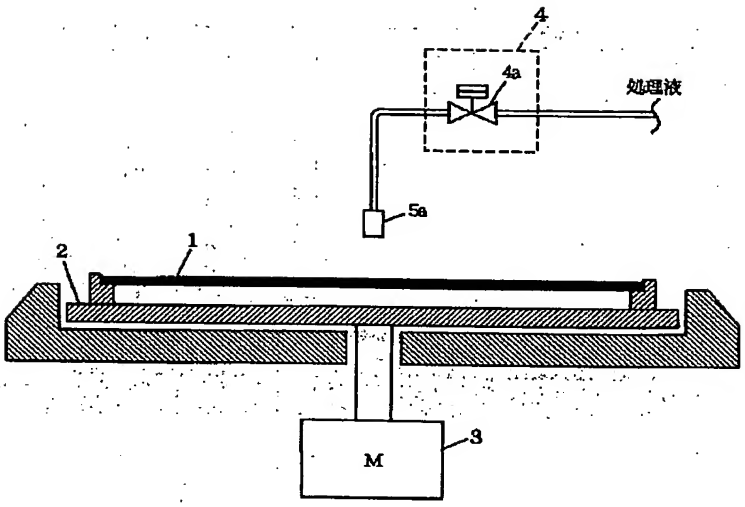
【図１】



【図３】



【図４】



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